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Author(s): Granqvist, Nina & Ritvala, Tiina
Title: Beyond Prototypes: Drivers of Market Categorization in Functional Foods and Nanotechnology
Year: 2015
Version: Post print

Please cite the original version:

Granqvist, Nina & Ritvala, Tiina. 2015. Beyond Prototypes: Drivers of Market Categorization in Functional Foods and Nanotechnology. Journal of Management Studies. Volume 53, Issue 2. 210-237. ISSN 0022-2380 (printed). DOI: 10.1111/joms.12164

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Beyond Prototypes: Drivers of Market Categorization in Functional Foods and Nanotechnology

Nina Granqvist

Department of Management Studies

Aalto University

P.O. Box 21230

00076 Aalto, Finland

Phone: +358 50 5951759

nina.granqvist@aalto.fi

Tiina Ritvala

Department of Management Studies

Aalto University

P.O. Box 21230

00076 Aalto, Finland

Phone: + 358 40 353 8352

tiina.ritvala@aalto.fi

Abstract. We develop a nuanced understanding of what drives producers' and audiences' categorization activities throughout market category development. Prior research on market categories assumes prototypical similarity to be the main or even only driver of categorization. Drawing on a comparative, longitudinal case study of the market categories 'functional foods' and 'nanotechnology' in Finland, we find that evolving perceptions, knowledge, and goals also impact categorization. Furthermore, our analysis uncovers that goal-based categorization is characteristic for vital market categories, and the lack thereof may mark a waning interest and category decline. Overall, while previous research stresses the role of clear boundaries and knowledge bases for a viable category, we find that overly strict boundaries may constrain category vitality and renewal.

Keywords: categorization, comparative study, functional foods, market category, nanotechnology

INTRODUCTION

When [officials within] the EU discovered that it [nanotechnology] is a future field and one needs to invest heavily in it, everybody started to interpret their work as nanotechnology because it gives you research money and time. Then someone came up with the idea that nanotechnology is dangerous, and as a result everyone said that what we do is not nanotechnology. –Vice President, consumer products company

This quote illustrates that categorization is an evolving activity covering different stages of market category development – a topic that very few studies have examined. Market categories are defined as economic exchange structures among producers and consumers that are agreed by these participants and various other audiences (Kennedy, 2003; Navis & Glynn, 2010). Thus, they are negotiated and contextually embedded socio-cognitive entities (Khairé & Wadhvani, 2010; Porac et al., 1989; Rosa et al., 1999). Market categorization – the focus of this study – in turn, refers to “a cooperative venture between organizations and their audiences, rooted in cultural understandings and expectations” (Glynn & Navis, 2013, p. 1125). Participants’ varying contexts and interpretations therefore provide leeway for categorization activities (Glynn & Navis, 2013; Granqvist et al., 2013). Moreover, categorization is influenced by several drivers from early to mature stages of market category development. Given this inherently dynamic nature of market categories, it is surprising that the understanding on what drives market participants’ acts of categorization remain fairly static.

Categorization at its core is about clustering together things and concepts that are in some ways similar (Mervis & Rosch, 1981). Previous studies have explored market categorization as being guided by prototypical similarity, this referring to individuals’

judgments of how similar an object is to the most representative exemplar of a category, based on its observable features (e.g. McKendrick et al., 2003; Hannan et al., 2007). While an overwhelming majority of the research does not account for alternative drivers of categorization, recent studies have begun to challenge the dominance of this so called prototype view. For example, Durand and Paolella (2013) discuss three approaches where assessing similarity is but one. The others are knowledge-driven categorization, where actors' prior knowledge and expertise shape their evaluative schemas (also Rehder, 2003a, b; Rottman et al., 2012), and a goal-based approach, where actors' pre-conceived goals and grievances influence their acts of categorization (also Barsalou, 1983; Fiske & Taylor, 2013). Similarly, recent empirical studies explore categorization as a dynamic process, covering the foundations for valuation (Khaire & Wadhwhani, 2012), variations in audiences' perceptions (Pontikes, 2012), category producers' subjective interpretations of category meanings and labels (Curchod et al., 2014), and their opportunistic uses (Granqvist et al., 2013). This body of research shows that actors' understandings and goals are in constant flux, therefore influencing how they might categorize offerings.

Studies on market categories, however, overlook what drives participants' acts of categorization over time. Research on category emergence and growth suggests that categorization activities tend to be both tentative and opportunistic (Aldrich & Fiol, 1994; Granqvist et al., 2013; Navis & Glynn, 2010; Santos & Eisenhardt, 2009). Studies addressing mature market categories, forming the vast majority, maintain that prototypical similarity and conformity drive categorization (Dobrev et al., 2006; Hannan et al., 2007). This is a result of a categorical imperative, where deviations from established expectations are sanctioned (Zuckerman, 1999). Declining market categories, again, seem to be sites for opportunistic participation in multiple categories (Kovács & Hannan, 2010; Negro et al. 2011). Yet, due to the lack of longitudinal studies, we have little understanding on why and how participants

categorize offerings during different stages of market category development (also Kennedy & Fiss, 2013). Neither do we fully understand their roles and motivations. These issues may have fundamental implications for the vitality and persistence of the category. We set out to explore, *what drives market participants' categorization activities during different stages of market category development?*

Empirically, we study these drivers during the development of two science-based market categories in Finland: the consumer-driven functional foods category (that is, foods with a demonstrated positive effect on health beyond basic nutrition), and the policy-driven nanotechnology category (science and technology in the size scale of 1-100 nanometers). Science-based market categories, rooted in advances in basic and applied research, develop over a long period of time, and encounter heterogeneous category audiences ranging from scientists to laymen, making them rich contexts to study categorization. A longitudinal approach allows an examination of the presence and interplay of varying drivers throughout category development. The comparative setting, in turn, is critical for exploring the context specific and more general drivers of categorization. The two cases exhibit similarities and interesting analytical differences. For example, functional foods was characterized by consumer interest and regulation, whereas nanotechnology was mainly driven by a policy interest. Finland provides an institutionally bounded context for comparison, with the same science funding and public sector organizations present in both cases.

Drawing on this analysis, we make several contributions to understanding market categorization as an evolving activity. Our study augments the recent conceptual research (Durand & Paoletta, 2013; Kennedy & Fiss, 2013), by empirically demonstrating how producers and audiences with varying perceptions, knowledge and interests engage in categorization. We show that each categorization principle – prototypes, causality, and goals – form part of different stages of category development, and we discuss their co-occurrence.

Further, we uncover that goal-based categorization is a sign of a vital market category, and the lack thereof may predict category decline. Finally, and in contrast to the previous research stressing the role of clear boundaries and knowledge bases for a viable category, we find that overly strict boundaries may constrain category vitality and renewal. Our study invites further research exploring how market participants engage in categorization in practice.

MARKET CATEGORIZATION DURING CATEGORY DEVELOPMENT

With the aim to develop a more varied understanding of what drives market categorization, scholars have begun to divert attention from the dominant focus on prototypes. This shift involves an interest in audiences' knowledge and expertise in ambiguous contexts, actors' interests and motivations for categorization, and the actual practices in both categorizing offerings and evaluating potential candidates (Glynn & Navis, 2013; Granqvist et al., 2013; Pontikes, 2012). We begin this section by discussing different drivers of market categorization. Thereafter, we review the previous research for the assumptions of what drives categorization during different stages of market category development.

Drivers of Market Categorization

This study considers market categorization as a process of negotiation, and market categories as continuously changing, dynamic entities that actors reproduce through their interactions (Glynn & Navis, 2013; Khairi & Wadhvani, 2010; Rosa et al., 1999). In terms of the underlying drivers of these exchanges, prototypical similarity is central, but not the only driver of categorization; those less explored include the role of previous knowledge and actors' goals and interests (Durand & Paoletta, 2013).

In terms of prototypical similarity, category research traditionally examines how actors cluster entities based on their similar observable features (Mervis & Rosch, 1981). Several studies assume that similarity of key features, such as technology, resources and customers, is

the only driver of market categorization (Hsu, 2006; McKendrick et al., 2003). Once an offering or a firm gains the status of a prototype, this affords a cognitive template and increased stability to the category. The prototype then becomes the key reference point against which actors negotiate category memberships. As a result, the category entrants begin to reproduce the features that the prototype exhibits (Kovács & Hannan, 2010). However, at the same time firms strive to establish that they are sufficiently different from other offerings in the category (Hannan et al, 2007; Zuckerman, 1999). In the midst of these pressures of being similar and yet different, the survival of firms and products is dependent upon signaling coherent membership in a single category so as to guarantee inclusion and beneficial evaluations of various audiences (Hsu, 2006; Pólos et al., 2002). As an example, launched in 2010 the iPad quickly became the prototype for the category of tablet computers, differentiating the category from both laptops and mobile phones. To date, the products within this mature category are very similar with minor differentiating features such as color, shape, or size, and some elements of usability.

However, recent studies argue that previous research may have overemphasized the role of similarity as the only or main driver of categorization. Building on cognitive psychology, the causal-model approach is based on the premise that previous knowledge and expertise are crucial for constructing evaluative schemas and assessing participation in a category (Durand & Paolella, 2013; Rehder, 2003a, b). Studies have uncovered that different levels of knowledge lead to varying categorization outcomes in that non-experts tend to categorize objects based on observable features or plausible resemblance, whereas experts employ domain-specific causal knowledge (Proffitt et al., 2000; Rottman et al., 2012). Particularly, this may be the case in highly specialized or ambiguous market categories where audiences may lack the necessary knowledge to judge membership claims (Granqvist et al., 2013; Pontikes, 2012). For example, in the emerging market category of spintronics, extensive

professional knowledge is required to assess whether information is stored by exploiting the spin of the electron, or whether the technology is based on giant magnetoresistance, warranting categorization to the GMR devices category. Further, studies show that category meanings and boundaries are embedded in the broader field context, resulting in that participants need to understand shared values and history (Khair, 2014; Khair & Wadhvani, 2010). Accumulation of knowledge transforms the schemas of market participants, which shifts category boundaries over time (Durand & Paoletta, 2013; Khair & Wadhvani, 2010). Previous knowledge is therefore an inherent driver of actors' categorization of offerings.

Finally, the key aspect of market categories is that they are domains of economic activity where outputs are produced and sold, with the aim of making profit, or to survive. Several studies have shown that varying interests influence both producers' and audiences' acts of categorization, which in turn has an impact on how category boundaries are negotiated (Navis & Glynn, 2010; Pontikes, 2012; Rosa et al., 1999). Examining cognitive foundations, Barsalou (1983) found that people habitually construct ad hoc categories to achieve various goals. Categorization may thus rest on prior intentions in that "audience members first define a goal, and only afterwards do they observe and organize the reality into categories of objects likely to help them reach their goal" (Durand & Paoletta, 2013, p. 1109; also Fiske & Taylor, 2013). Market categorization is not only based on cognitive and automated decisions, but also on reflective choices, occurring in specific situations. For example, a firm that produces advanced biodegradable materials may be categorized as both biotechnology and waste management. From the firms' perspective, biotechnology may be a "better" market category than the alternative when funding for development and acclaim for membership are available. From the regional government, or audience perspective this categorization may be preferable when the goal is to exhibit that a biotechnology cluster exists. In contrast, waste management might be a more suitable category when the firm seeks green credentials. Empirical studies

have established that such instrumental goals are prevalent, and that category labels act as the tools for strategic categorization (Granqvist et al., 2013; Santos & Eisenhardt, 2009; Vergne, 2012). Market categorization may thus be driven by category participants' specific goals rather than the similarity of features, or solely previous knowledge.

In summary, several studies show that actors employ varying principles when they associate firms and offerings to market categories. However, these studies do not explore activities throughout the different stages of category development. We next review the studies exploring varying stages, indicating differences in categorization.

Drivers of Categorization during Market Category Development

There is an extensive body of empirical research that addresses different stages of market category development. While not explicitly examining the drivers of categorization, studies hold important assumptions on these. In the following, we explore these assumptions so as to create a foundation for our comparative analysis.

Drivers during category emergence and growth. A new market category may have its origins in, for example, an invention of a new product or service, a gradual differentiation and repositioning of existing offering, or a change in regulation. In novel market categories, assessing similarity among possible category entrants is challenging because shared understandings about the core features do not yet exist (Hardagon & Douglas, 2001; Kaplan & Tripsas, 2008). Further, regarding causal or theoretical knowledge as a driver of categorization, particularly in technological and scientific fields, outsiders have only limited understanding of the core technologies (Santos & Eisenhardt, 2009). There are, by definition, few experts who are able to evaluate potential category entrants based on more complex principles than solely on apparent similarity (Rottman et al., 2012). In terms of goals and interests, actors hold mixed understandings of the future potential such that might provide incentives to participate (Granqvist et al., 2013). Category emergence is thus characterized by

lack of prototypes and shared knowledge base, as well as unclear motivations to join in, or identify members in a category. Both producers and audiences are producers of category meanings and boundaries during this stage, and the actor roles are blurred.

The transition from emergence to growth is typically marked by some level of legitimation, which may relate to a prototype – for example, a successful product or service (Navis & Glynn, 2010) – or to an audience endorsement, such as influx of funding and investments (Granqvist et al., 2013). Legitimation leads to growth because it encourages participation in the category (Aldrich & Fiol, 1994). More dedicated meaning systems develop and the knowledge base gradually becomes more distinct within the category. Hence, there is also an increasing number of actors with capabilities to judge the validity of membership claims. However, studies show that membership assessments are much influenced by plausibility of the identity claims, this being driven by the resonance of the claims with actors' interests, values and existing business concepts (Lounsbury & Glynn, 2001; Navis & Glynn, 2011; Santos & Eisenhardt, 2009). In this process, rather than causal knowledge or clear prototypes, the preconceived goals and interests such as accessing new business areas are important (Durand & Paoletta, 2013; Fiske & Taylor, 2013). Studies indicate that category straddling – participating in many categories simultaneously – may be a goals-related response to ambiguity, for example for firms protecting themselves against the potential collapse of a yet unstable category (Granqvist et al., 2013). Studies, hence, assume multiple drivers of categorization during emergence and growth.

Drivers during category maturity. A market category moves from a growth to a mature stage when producers and audiences begin to share coherent schemas and scripts about firms and their offering (Hsu, 2006; Navis & Glynn, 2010; Zuckerman, 1999). Studies assume that in such contexts there is a clear division of roles between producers and audiences. This stage is characterized by the dominance of the categorical imperative in that “if organizations do

not meet institutionalized expectations for how they should look and act they are viewed as illegitimate” (Zuckerman 1999, p. 1399). Therefore, producers need to signal coherent memberships and deviations are sanctioned, which leads to a reduction in variety within the market category (Zuckerman, 1999). Audiences, in turn, have established principles for evaluation and attributing identity labels to firms and their offerings based on their features (Dobrev et al., 2006). Categorization based on the prototypical features further sharpens the category contrast towards other categories (Kovács & Hannan, 2010). As a result, categories are distinct from each other, and firms within them aim to establish optimal distinctiveness and differentiation (Hannan et al, 2007; Kovács & Hannan, 2010). In mature categories, categorization activities by both producers and audiences therefore revolve around reproducing the existing meanings and hierarchy in the market category, which further maintains stability. Overall, these studies assume prototypical similarity as the driver of categorization activities, overlooking alternatives.

Drivers during category decline. Previous research has uncovered several reasons for why market categories decline. First, this may happen as a result of losing, or failing to achieve, a coherent set of knowledge bases and meanings, which are a requirement for having a clear contrast towards other categories (Kovács & Hannan, 2010; Rao et al., 2005). This may be an outcome of actors straddling memberships in several categories and spanning category boundaries. Both activities indicate a lack of dedication to the category, thereby jeopardizing coherent identities for participating firms (Hannan et al., 2007; Kuilman & van Driel, 2013; Negro et al., 2011). The resulting weaker category contrast leads to less appeal for the membership (Kovács & Hannan, 2010). Yet, extreme coherence of a category may also have a negative effect. If the category schema is very constraining there may be fewer firms that can participate in the category, which again reduces memberships (Kuilman & van Driel, 2013). Second, a market category may decline as a result of a stigma that it carries, or a

stigmatizing event that leads the category to losing its legitimacy (Alexy & George, 2013; Devers et al., 2009; Hudson & Okhyusen, 2009). For example, a major chemical hazard may lead chemical firms to seek alternatives and position themselves as materials or catalyst companies.

Third, a category may lose its salience owing to regulation, such as prohibition, or innovation or change in the practices of conducting business (Kuilman & van Driel, 2013), for example making fax machines obsolete. As a result, there is a weaker appeal for being associated with the category, which results in category straddling, or firms leaving the category altogether (Vergne, 2012). These studies suggest that prototype and causal knowledge gradually lose their role as the key drivers of categorization. In the above studies, diminishing resonance of the market category leads to that participants do not see it as worthy of participation. In this sense, category straddling may also be driven by actors' goal-based categorization. These studies are thus inconclusive about the drivers during the market category decline.

In summary, although not their explicit focus, empirical studies suggest that prototypes, knowledge, and goals may each be influential drivers of market categorization activities. However, previous empirical studies remain agnostic on how these drivers occur during different stages of category development (Kennedy & Fiss, 2013). As a result, we lack understanding of what actually drives market participants' categorization activities. To address this issue, we next explore how actors engage in categorization throughout the development of the functional foods and nanotechnology categories in Finland.

RESEARCH METHODS

Our fieldwork is based on a longitudinal comparative case study, and it draws on a social constructionist approach. Accordingly, we see categorization as a process where

producers and audiences construct and negotiate category meanings locally, over time. During this negotiation, participants' roles may be blurred and changing rather than clear and distinct. We, as investigators, construe this process through collecting and analyzing historically and socio-culturally embedded stories that category members produce during the interviews and in the media outlets (Rosa et al., 1999).

We follow a case study approach – understanding the contextual conditions and processes that influence category development requires longitudinal, deep case analysis (Kennedy & Fiss, 2013; Nigam & Ocasio, 2010; Rindova et al., 2011). Comparing two cases allows us to combine the contextual insight of a single case with a broader understanding of meaning construction (Dyer & Wilkins, 1991; Stake, 1995). We selected the cases based on a “matched-pair” case study approach (Buck et al., 2000), which allows meaningful comparison of varying drivers of categorization. Following this design, we hold three central factors constant – country context, key public institutions, and the science-based nature of the categories. This permits us to compare processes of categorization across two sufficiently similar settings. Further, in both cases the stage of the market category development forms the primary context of our comparative analysis. Importantly, our comparative study on the categorization drivers enriches the recent theorizing on the topic, dominated by several conceptual studies (Durand & Paoletta, 2013; Glynn & Navis 2013; Kennedy & Fiss, 2013).

Setting for the Comparative Research

Functional foods and nanotechnology provide a theoretically interesting context for a comparison. With their origins in basic and applied research, they represent science-based market categories that typically have strict boundaries for membership claims (Collins, 2000; Gieryn, 1983). But as we analyze in length below, even in such contexts participants' categorization may have much variance. While functional foods and nanotechnology exhibit astonishing similarity, for example in terms of the policy interest and public funding schemes,

a closer examination reveals significant differences in their development. For instance, while functional foods emerged bottom-up, as an outcome of scientific research, nanotechnology development was much induced through a top-down policy initiative.

Figure 1 describes the key events in the development of both categories. We have paired these events with the analysis of news stories, the curve exhibiting how the pattern of attention was very similar across the cases with rapidly peaking and declining interest during and after the growth stage. Despite a waning media attention, the actual development of the categories took quite different paths after their apparent rapid growth. Before moving to the comparative analyses, we provide a brief description of each market category.

INSERT FIGURE 1 ABOUT HERE

Functional foods. The European Consensus Document defines that “a food can be regarded as ‘functional’ if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease” (Diplock et al., 1999, p. S6). The roots of this market category in Finland were built on local health issues and a strong research base in relevant fields within universities and research institutes. Introduced in the 1970s, the first prototypical Finnish functional foods product was Xylitol, a sugar sweetener that is extracted from birch trees preventing tooth decay (caries). Another significant product was Benecol margarine, which lowers the level of serum cholesterol, a major risk factor for heart disease. The commercial launch of Benecol, backed by the publication of its clinical test results in the prestigious *New England Journal of Medicine* (NEJM) in 1995 (Miettinen et al., 1995), was instrumental in triggering the emergence of the functional foods category both locally and globally. Towards the end of 1990s, the wide

interest gave rise to an explosion of products labeled as “functional”, many of these being unwarranted claims, resulting in a need to regulate entry to the market category.

Nanotechnology. Nanotechnology refers to “the construction and use of functional structures designed from atomic or molecular scale with at least one characteristic dimension measured in nanometers”, that is between one and one hundred nanometers (Wang, 2004, p. 28). This definition lacks specificity as it encompasses several domains within natural sciences (especially in physics, chemistry, and material sciences), and many technologies in varied industries such as semiconductors, textiles, biotechnology – and even foods. Research activities in this size scale were not labeled “nanotechnology” until the mid-1990s. In Finland, the category emerged in response to the need for new collaboration among the key science funding institutions – the Academy of Finland focusing on basic research, and the Technology Agency engaging in applied research and commercialization. In 1997, these organizations jointly launched the Nanotechnology Research Program, this being among the first such programs in the world, forming a benchmark for later initiatives. The launch of the National Nanotechnology Initiative in the USA in 2000, and the establishing of nanotechnology as a strategic focus area in Japan in 2001, and in the EU in 2002, legitimated nanotechnology globally. The resulting flood of funding and interest prompted scientists and businesses to reposition their activities within this category.

Data Collection

We draw on several sources of qualitative materials in order to obtain a rich understanding of drivers of market categorization throughout the category development. Our primary data source is in-depth interviews that allow us to explore how both producers and audiences engage in categorization of offerings and, more specifically, how their roles and drivers of categorization develop over time. Initially, we conducted 54 interviews between August 2004 and April 2008, during which time both categories were established. Later, in 2012, we

conducted a further six interviews with the key informants so as to trace the changing perceptions during a time when actors were leaving the category. The total of 33 functional foods interviews comprised thirteen scientists, fifteen firm representatives, and five funders or regulators. Respectively, the 27 nanotechnology interviewees included eight scientists, eleven firm representatives, and eight funders or regulators. Interviews lasted between one and four hours, and were recorded and transcribed before analysis. We selected our first informants by identifying the key individuals from varying sources, such as reports and programs of national and international events. During our fieldwork we also identified other important actors through snowball sampling (Patton, 1990). Finally, as our theoretical insights sharpened we selected the later six informants based on their extensive experience of the respective categories. This enabled them to evaluate the drivers of categorization during category decline. The flexible, iterative identification of informants was necessary for such an inductive study (Gioia et al., 2013).

In addition, we examined reports, analyses, and other empirical studies so as to avoid retrospective bias that is usually associated with interview accounts (Lofland & Lofland, 1995). Further, we collected news stories, an approach that previous studies have used to examine the development of market categories (e.g. Navis & Glynn, 2010), as they act as a site of construction and dissemination of shared cultural meanings (Zilber, 2006). We searched for articles by using words *funk*elint** and *terveysvaik* elint** (in Finnish, equivalent to *funct* food** and *health promot* food*) for functional foods, and *nanotek** and *nanotie** (*nanotech** and *nanoscie**) for nanotechnology from Helsingin Sanomat, the main national newspaper, and Kauppalehti, the principal business newspaper, during the period of 1992-2011. This period covers the developments from category emergence to maturity for functional foods, and the apparent decline for nanotechnology. We found a total of 1247 news stories, 633 for functional foods and 614 for nanotechnology. The newspaper data allowed us

to comprehensively identify the category producers and audiences, and to identify the key issues and drivers of category development.

Data Analysis

We adopted an inductive, iterative approach (Easterby-Smith et al., 2008; Gioia et al., 2013; Langley & Abdallah, 2011), with an aim to generate understanding on what drives the categorization activities during different stages of category development. This approach enabled us to reiterate between the emergent understandings and the current debates on categorization. The aim of our analyses was to identify how our informants, both category producers and audiences, perceived the category development, and to trace the related drivers of categorization, and their interaction and fluctuation over time.

We began by examining interviews and a variety of reports so as to identify the key events in the development of both categories. Based on this analysis, we created chronological narratives (see Figure 1 for one such abstraction). Using these narratives, we conducted initial comparative analyses to identify common themes (e.g. lax and diffuse labels giving rise to ambiguity for the category) and divergent themes (e.g. narrowing definitions and emerging prototypes versus the lack of these) among the cases (Strauss, 1987). This was followed by a fine-grained analysis of the activities related to category formation and development, for which we conducted several rounds of iterative, comparative analyses.

After these inductive and iterative stages we began to explore the emerging themes. At this stage our approach was abductive, where our data and relevant literatures were considered in tandem, that is, in a critical dialogue (Alvesson & Kärreman, 2007; Gioia et al., 2013). This is in accordance with the constructivist approach where findings are mediated through a conceptual framework, through which knowledge claims are evaluated (Schwandt, 2000). We identified that our findings resonate strongly with the on-going debates around the

dynamics of market categorization (Durand & Paoletta, 2013; Glynn & Navis, 2013; Kennedy & Fiss, 2013).

This focused our analyses towards examining actors' passages where they describe how they or others engage in market categorization in different stages of the category development. During this analysis, we found that identifying prototypes and assessing their key features drove actors' market categorization activities. A typical passage is, "*Benecol was the first product of this kind [with health benefits] and with it started the whole discussion on functional foods*" (Director, public health organization). But rather than prototypicality being the main or the only driver of categorization, we uncovered that knowledge and causality played a major role. In the functional foods case this was particularly evident as the causal link between consumption of a food and a health benefit required proofs. An example of such quote is, "*functional foods are products that have been shown in scientific studies to have health-promoting or sustaining properties*" (Helsingin Sanomat, February 20, 1996). As a third driver, many actors exhibited how varying goals and interests influenced their market categorization. An example of such passages is: "*nano-label has come around with the recent hype [and associated funding] and it is used so much that it makes me sick*" (CEO, photonics company). After having identified the presence of these drivers of categorization, we explored how they occurred throughout the development of both market categories.

INSERT FIGURE 2 ABOUT HERE

Finally, to gain a yet more comprehensive understanding of the drivers, and to further place these activities into their historical and cultural context (Forbes & Kirch, 2011; Glynn & Navis, 2013), we augmented the interviews with content analysis of news stories. Such analyses are essential because the media has a strong influence on how various actors and broader society begin to perceive the category (Schultz et al., 2014; Vergne, 2012). We traced

references to different groups of actors so as to have an understanding of who participated in each stage (Figure 2). After looking through a sample of 100 news stories for each case, we identified five groups: scientists, firms, funders, regulators, and consumers/popular culture. For the few unclassified examples we established the category “others”. From our 1247 news stories we identified a total of 1238 different observations regarding actors (689 for functional foods and 549 for nanotechnology). Some of the news stories covered more than one group of actors, which we subsequently coded into different categories, whereas others did not make any such references, and thus remained uncoded. Additionally, we examined the kinds of drivers of categorization that were present in actors’ statements as they were quoted in the news sources.

DRIVERS OF MARKET CATEGORIZATION IN FUNCTIONAL FOODS AND NANOTECHNOLOGY

In the following, we compare the drivers of categorization across the cases so as to develop insights into our research question: *what drives market participants’ categorization activities during different stages of market category development?* Table I provides an overview of the key actors involved and of the drivers of categorization that we identified. The table shows how the different cases and phases are dominated by varying actors and activities, yet, sharing a peculiar similarity during category growth. It also exhibits the ways by which producers and audiences are in interaction throughout category development. In the remainder of this study, we discuss these dynamics and their implications. In our analyses, we refer to illustrative quotes of categorization presented in Table II.

INSERT TABLE I ABOUT HERE

INSERT TABLE II ABOUT HERE

Category Emergence

Functional foods, 1990-1996. The birth of the functional foods category was triggered by bottom-up local health issues and categorization activities that were driven by causal theorizing. For instance, a Principal Investigator in a heart disease prevention program, explained the origins for innovation in cholesterol-lowering functional foods: *“There was an emergency call in Finland: the mortality rate from heart disease was the world highest ... and high blood cholesterol-level is a major causal risk factor for heart disease”* (see also Table II: 1.1-1.3). The scientists, as the key category producers, were able to scientifically substantiate the causal link between consumption of specific food ingredients and reduced disease risk. Causal theorization was also evident in the news stories where the concept of functional foods was discussed in terms of the link between consumption of a specific food product and incidence of disease/risk factor. These news stories also often raised the need for new regulations for the emerging category, blurring the distinction between food and medicine (see also Figure 2).

Initially food manufacturers were not convinced about participating in the functional foods category. Significant persuasion was required from scientists and corporate R&D people to convince the top management to invest in this risky new category. However, the successful launch of cholesterol-lowering margarine Benecol in 1995 marked a turning point for functional foods, and pushed the category into rapid growth (see Figure 1). As expressed by industry analysts: *“no other product on the world food stage came to symbolize the power and potential of the functional food concept more than Benecol margarine did”* (Heasman & Mellentin, 2001, p. 34). This rapidly inspired the broader audience, such as funders, to participate in the category. As explained by an Emeritus Professor: *“it was probably this ecstasy around Benecol that mobilized the Technology Agency and other public funding bodies.”* Thus, along with the interest around Benecol, which rapidly became a prototypical

product, the domination of causal-driven categorization started to provide space for prototypes and interests as drivers of categorization, and pushed the category to growth.

Nanotechnology, 1992-2000. In contrast to functional foods, the emergence of the nanotechnology category was a top-down activity, driven by the goals and interests of a handful of actors aiming to bridge local public funding organizations. Drawing on their own education and interests, experts at the Academy of Finland and the Technology Agency identified nanotechnology as a suitable novel domain where a new type of collaboration could be developed which was “*politically valuable*” (Table II: 1.4). One responsibility of the Technology Agency is to engage in the commercialization of science. A significant aspect of the daily work of its technology experts is to identify and nourish seeds for nationally important industries. They considered that nanotechnology had this potential, and early investments in the area were necessary. These technology experts, thus, had much influence and resources in constructing nanotechnology as a new market category. Triggers for the emergence, or rather creation, of the category were driven by these interests and goals.

As a result, definitions and meanings of nanotechnology were discussed within committees that decided upon the funding principles. However, the general definition of nanotechnology as activities in the size scale of 1-100 nanometers did not provide sufficient boundaries for the field, and boundary drawing became a political process driven by varying interests. Scientists wanted to define the category in a narrow sense to accommodate their own activities and direct funding to their domains of research (1.5). In contrast, the public funding agencies with the power to make this decision opted for broad and lax boundaries in order “*to obtain sufficient numbers of good applications*” for the technology program under way (Technology Analyst, public funding organization) and to have some choice over whom and what activities to include in the emerging category. As a result, many scientists considered nanotechnology as “*an unnecessary rhetorical innovation*” (Research Scientist,

consumer electronics firm), which distorted research from its true and worthy goals. The Research Scientist laconically noted, “*researchers had identified [the novel category] and noticed that if money is not there yet, it will soon be*”. As a result, a new source of funding with fuzzy boundaries, combined with the interests to grow the category, allowed a variety of activities to enter, which pushed the category to a growth path (see Figure 1). In this sense, goal and interest-driven refocusing of existing research and business activity created an embryo for a novel market category.

Comparison. Table I visualizes the comparison of the drivers of categorization. In functional foods, causal dynamics initially drove category emergence. Scientific discoveries and their commercialization into products played an important role in the birth of the category. These products established a causal link between consumption of the specific food and a positive health benefit, thereby, over time, triggering a change in the meaning system related to foods and dietary habits that underlay the entire category. Hence, the functional foods category had strong scientific roots, with a widely shared and identifiable knowledge base. Scientists, with professional knowledge, held key roles in category creation and legitimation, thus building a solid foundation and eventually also regulating access to the emerging category.

In contrast, in nanotechnology definitions and boundaries were rather decided within committees. As a result, the nanotechnology label became an organizing principle bringing together many previously disjointed activities, but these activities lacked sufficient similarity and cohesion. Categorization during emergence stage was goal-driven because nanotechnology was seen as a means to produce new collaborations, and the consequent funding created many incentives to claim membership. Moreover, the roles of producers and audiences were blurred as funders both created the category and evaluated entrants, and themselves had an interest to establish growth in the category.

Category Growth

Functional foods, 1997-2000. During the growth stage, very similar categorization dynamics were visible across the cases. In functional foods, Benecol had become the prototypical product, resulting in that category meanings began to cohere (Table II: 2.1). This status as a prototype is reflected in that during the growth stage up to half of the functional foods news stories referred to Benecol. Its successful launch in Finland triggered a tenfold increase in its manufacturing company's share price and the interest of other food manufacturers to launch similar products. As a Director lamented: "*Benecol already existed as an innovation, and then came these 'me too' products, which, of course, from our perspective are annoying*" (see also 2.2 and 2.3). In addition, the policy efforts in making Finland the "*Silicon Valley of Functional Foods*" intensified towards the late 1990s (Heasman, 2000). At the confluence of growing international competition, and the creation of the National Industrial Strategy for Finland, redefining industrial policy following the ideal type of Porterian industry clusters (Ylä-Anttila & Palmberg, 2007), the Technology Agency launched the first technology program in foods in 1997. This type of governmental funding became a significant incentive for a number of smaller functional foods firms to join the market category. Taken together, the funding marked a clear transition from causal-driven categorization to goal-based categorization, when firms began to label both novel and existing food products as "functional".

This period also saw a significant change in the macro-cultural discourse on functional foods, making the introduction of (often symbolically) new products easier because they could be placed under the broader umbrella label. As a Vice President of a dairy company noted: "*This [late 1990s] was a time when no matter what functional foods product one would have launched, everything would have been sold.*" Indeed, the period saw the commodification of healthiness, which was reflected in slogans such as "*revolution in*

nutrition” (Heasman & Mellentin, 2001, p. 55) and that food “*has become the primary vehicle to transport us along the road to optimal health and wellness*” (Hasler, 2000, p. 499). Resulting from goal-based categorization, a vast number of dubious products and means that “*cannot stand the light of day*” entered the market (2.4). It became evident that the category required clearer boundaries. In 1999 over 70 scientists working in companies, universities and research institutes agreed on the Consensus Document. This played a key role in the formation of category boundaries by requiring firms to scientifically prove a causal relationship between the consumption of a functional food and the claimed health benefits. It also established a clear boundary between this category and medicine: functional foods must remain foods, and not be pills or capsules. This reverting to causal-driven categorization reduced the possibilities for goal-based activities and marked the beginning of the mature period in the market category development.

Nanotechnology, 2001-2006. In nanotechnology, the market category growth was driven by very similar dynamics as those in functional foods, that is, goals and interests among both producers and audiences. Similar to functional foods, firms wanted to join in the category because of the available public funding for research and development, and attention and excitement among various audiences towards the category. Moreover, the audiences, particularly the actors within the public funding agencies, felt pressure to identify sufficient and good enough members for the category so as to demonstrate that a local cluster existed. This was accentuated by the European Union granting nanotechnology the status of a strategic focus area in 2002 with major funding flooding in to this segment, thereby giving rise to comparisons across regions to measure the number and type of activities. A director of a public funding agency expressed well the confluence of these pressures, “*the nano word got inflated ... it seemed to be a keyword if you wanted to apply for funding ... the whole proposal*

becomes sexier ... in my view only few of the applications and programs had nano elsewhere than in the title."

However, a shared knowledge base to assess the membership claims was lacking. A technology analyst in a funding organization stated, *"it [nanotechnology] may sound great but ...audiences do not understand what it means"*. As a result of the demand for a category and the lack of knowledge, firms were able to join in by merely establishing some level of similarity with nanotechnology as a size scale, which is reminiscent of prototype dynamics. Most typically, their technologies would reach to the micron scale, which indeed is small but still 1000 times larger than nanotechnology. In up to half of the cases entrants were not, by definition, nanotechnology companies (also Granqvist et al., 2013). For most firms, nanotechnology therefore provided a label to signal novelty and participation in cutting edge technologies without the need to refocus their activities (2.5). In this sense, membership in the category was a question of relabeling existing activities and *"purely business decisions"* (2.6) that yet contributed to the formation of a category. An example of this is a news story reporting how the number of nanotechnology firms had doubled in two years, from 61 in 2004 to 129 in 2006 (Kauppalehti, 12 February 2007). Rather than describing an increase in actual activities, as suggested by the news story and the report on which the story is based, this figure reflects how both producers and audiences began to assign the nanotechnology label to firms. This activity was driven by the demand for category memberships described above. According to our data, only a fraction of these firms were in any way dedicated to this category (see also 2.7). Thus, categorization practices for both producers to signal and audiences to grant memberships were predominantly goal-based.

Comparison. Table 1 shows that drivers of categorization during this stage were similar across the cases. Almost all related actors wanted to participate in these fashionable categories and benefit from the associated ample funding and positive reputation (this was reflected also

in the more varied actor base in the media associations shown in Figure 2). Therefore, goal-based categorization dominated the growth stage for both market categories. However, an exception was that authorities and regulators, as the key audiences in functional foods, began to apply strict rules for evaluating producers' products' beneficial effects on health. This is an example of causal-based categorization where professional knowledge plays a key role, which efficiently limited the potential for non-substantive, goals-driven participation. In contrast, in nanotechnology the key audiences did not have such requirements, but rather, growth in the category was beneficial for all parties, which further fed goal-based categorization. Moreover, the nanotechnology category on the whole lacked shared, coherent scientific foundations. As a result, the category continued to encompass a multitude of activities reaching to "a small enough" size scale that served as the proxy for prototypical similarity. This lack of substantive foundations gave rise to radically deviating development paths for the two market categories thereon.

Category Maturity and Decline

Functional foods, 2001-2011. As explained by our informants (Table II: 3.1), the category maturity was, to a large extent, an outcome of tightened regulation. While the boundary drawing of authorities and regulators resulted in coherence and stability for the category, the stringent rules restricted its growth and vitality. Indeed, the Regulation on Nutrition and Health Claims (EC No. 1924/2006), set requirements for comprehensive safety and efficacy evaluations of products making health claims on their packaging and marketing. Among the major contested issues was disagreement on the scientific methods used. As a Vice President, dairy company, stated:

"Even if you have published in these best journals of the field there is some statistician [at the European Food Safety Authority] who argues that the statistical method has not been used in a particular manner, so they invalidate the research [resulting in that the

company is not legally permitted to use a health claim]. Thus, they have taken a tougher stance [on functional foods] than the scientific community.”

These varying interpretations for research decreased the food industry’s willingness to invest in R&D because, due to regulatory uncertainty, it did not “*make sense to conduct research on functional foods*” (Vice President, dairy company, also 3.2).

On the other hand, rigorous scientific criteria reduced the number of obscure products in the market, increasing consumer confidence in functional foods. Yet, consumer enthusiasm for functional foods started to wane towards the mid-2000s, with other food trends such as organic food, and locally grown produce taking over. In this sense, audience attention began to divert to other food-related categories (3.3). However, well-established sub-categories and brands continued to serve consumers in this mature market because: “*Benecol, Proactiv, Gefilus... – these specific brands with credibility, they still manage [to make profit], but it is very difficult to launch anything new*” (Vice President, dairy company). Firms’ loss of interest did not go unnoticed by the Technology Agency, which in the 2010s was considering setting up a new technology program: “*On the one hand, this sector has a large impact on the well-being of the population but, on the other hand, should artificial respiration be stopped if the industry’s willingness to invest is minimal?*” (Tekes, 2012: 57). While the future of functional foods remains obscure, it seems certain that consumers’ health consciousness is a sustaining trend, and the debate on making the regulations more transparent and supportive for category participants continues.

Nanotechnology, 2007- 2011. It appears that nanotechnology moved directly from growth to decline as a market category. This is a result of a vanishing audience commitment, and a lack of engagement among most producers. Public funding agencies, as both the category producers and the key audiences assessing memberships, gradually lost interest in the category. They began to direct funds to other domains when the technology programs

came to end. As the category was no longer constantly fuelled and there were very few committed firms, the incentives to participate ceased to exist. Similar to functional foods, at this time, other related market categories emerged and attracted the same actors (3.4).

For scientists, there were few incentives to categorize their research as nanotechnology. Within science, the label referred to but one set of tools available for research, and not to any coherent field or domain of research (3.5). Thus, scientists were not committed to the category to begin with. In a similar manner, among companies increasing experience and knowledge about nanotechnology led to an understanding that it is an enabling technology forming part of the production process within several market categories, rather than a market category in its own right (3.6). With regard to prototypes, while there were several products that benefited from and exhibited the features of nanotechnology, none of these gained a truly prototypical status. This played a further role in the category decline. The attention of businesses began to gravitate towards other market categories where their firms might gain better visibility and fit. Simply put, nanotechnology as a market category was no longer seen as “relevant” or “sexy”, which was driven by “*the stage of negative hype [in 2009][and] great disappointments because not much private money had been invested*” (entrepreneur, materials company). In other words, having strong goal-based roots, once the incentives to be part of the category gradually eroded so also did the activities in the category. The outcome of this process is still open, and it remains to be seen whether any persistent, substantive foundations were formed in the course of actors’ symbolic associations with the nanotechnology category.

Comparison. Although our data allows limited room for making causal claims about category development, we find a strong indication that the different drivers of categorization during category emergence and growth resulted in dissimilar development paths thereon. Table 1 shows that in functional foods, strict boundary drawing reduced the growth and

vitality in the category. Because firms had substantially invested in the category, it matured into a slowly growing category with few dominant firms and brands that continued to prosper. However, due to the strict regulation there were few incentives for firms to develop new products, or for new firms to enter the category. Owing to the advent of regulation, the roles of producers and audiences became markedly distinct.

In contrast, developments in the nanotechnology category were very different: overly goal-based categorization resulted in a lack of substantive foundations and cohesion within the category, which pushed it from growth stage directly to an apparent decline. Whereas in functional foods producers' commitment waned because of the strict regulation, the same happened in nanotechnology because the public funding agencies as category producers did not see sufficient dedicated activity, for example private investors taking over the financing. Therefore, the public funders ceased to fuel the nanotechnology category leading to its demise. In the following section we elaborate the contributions of our study and suggest some paths for future research on varying dynamics of categorization.

DISCUSSION AND CONCLUSIONS

This study contributes to the recent discussion on market categorization as a dynamic activity. It responds to Durand and Paoletta's (2013) call for developing a better understanding of categories and categorization, such that incorporates the role of varying drivers and actors during different stages of category development (also Kennedy & Fiss, 2013; Vergne & Wry, 2014). Drawing on our comparative research, we find that prototypes and similarity, previous knowledge and understanding of causality, and goals and interests, each drive actors' categorization, but to varying degrees during different stages. The study provides new insights into the conditions under which these drivers gain prominence and co-occur. We discover that vital market categories exhibit goal-based categorization, whereas declining categories do not.

Finally, and in contrast to the previous research, we find that overly strict boundaries may constrain – rather than enable – category vitality and renewal.

Goals and Interests as Foundational Drivers of Market Categorization

Market categories are the key contexts for exchange and dialog among market participants. Hence, they are important sites for performance, defining success and survival of firms. In this light, it is quite surprising that goals and interests as drivers of actors' categorization have been largely overlooked as explicit foci of empirical studies. Research on strategic categorization has begun to uncover how categorization is driven by participants' motivations to access funding and gain reputation (Navis & Glynn, 2011; Santos & Eisenhardt, 2009), or their aim to avoid negative evaluations (Vergne, 2012). In such situations, producers may claim memberships even when they do not have the necessary capabilities (Granqvist et al., 2013). These studies assume that audiences may accept the claims because they lack the relevant knowledge and understanding to demarcate “wannabes” from substantive firms and offerings.

We show that categorization is an outcome of negotiation of shared interests, and uncover aspects of this negotiation. Pontikes (2012) writes about market makers, or actors who construct new niches and enforce boundaries on them; these, in her study, being venture capitals and firms that introduce novel offerings. We explore this role further, in the context of a top-down effort to establish a new market category of which particularly nanotechnology is a case. While this context has been overlooked in the categorization literature, such efforts form a key part of technology policies in several countries and regions (Goorden, 2004) and impact business activities (Aldrich & Fiol, 1994; Murtha et al., 2001). We find that public funding agencies act as important market makers that often have a major incentive to establish growth in the category. Moreover, these agencies hold a major role in defining the legitimate knowledge bases to access the funding. Given their interests, they may draw lax boundaries

which supports category growth. When most of the parties involved have a shared interest to grow the category, interesting goal-based dynamics occur, giving rise to non-substantive associations.

Regarding the interplay between prototypes and interests, previous studies assume that the surfacing of a prototype ends the leeway for goal-based categorization (Woolley & Fuchs, 2011; McKendrick et al., 2003; Pólos et al., 2002). However, the functional foods case uncovers that prototypes may actually be important drivers of goal-based categorization. Usually the emergence of a prototype marks an economically vibrant stage in category development, when actors *en masse* begin to see value in participation. However, also related to the above point, the perceptions of similarity may vary, and they are strongly influenced by the goals of participants and the context in which evaluations happen. When shared interests exist, producers begin to simulate the prototypes, whereas audiences with interest to establish growth make plausibility judgments (also Navis & Glynn, 2011). In these judgments the actual features are less important than whether a particular categorization might *seem* legitimate. Not only producers, but also audiences assess what kind of categorization activities they *may get away with* so as to feed growth. Indeed, prototypes and goals as drivers of categorization co-occur in our data. Our study therefore deepens previous studies suggesting that plausibility and resonance may be drivers of category emergence and growth (Granqvist et al., 2013; Navis & Glynn, 2011) by uncovering some of the context, incentives, and negotiations that underlie these judgments.

Finally, our study shows that while goal-based categorization dominates the growth stage, this may also apply to any vibrant market category throughout its development. Goal-based categorization gives rise to heterogeneity among the firms and offerings in the category, which we argue is an important source for renewal. Moreover, the lack of goal-based categorization may be a signal of the waning interest of the category as a whole, marking its

decline. Further, the comparative study allowed us to uncover that it is not the prototypes per se, but rather the strong knowledge-driven foundations that form the key elements and restrictions for goal-based categorization. Next, we discuss our contributions to understanding knowledge-driven categorization during the category development.

Professional Knowledge and Contestation in Categorization

Knowledge plays a fundamental role in how people categorize objects because it forms part of the scripts and schemas that inform categorization (Fiske & Taylor 2013; Rehder, 2003a, b; Rottman et al., 2012). Yet, the role of knowledge and audience expertise has been an under-theorized topic in the categorization literature (Vergne & Wry, 2014). This neglect is surprising given that professional and domain-specific knowledge, in particular, create distinctions among actors within markets, and professionals more broadly speaking are important gatekeepers. Particularly the functional foods case shows that causal knowledge plays a major role in the emergence of market categories, and in assessing memberships. Novel scientific evidence established the causal link between specific food ingredients and disease risk, which triggered the birth of a market category at the interface of food and medicine.

Moreover, professional knowledge played a central role in the regulative domain. Along with the regulation of health claims, the roles of actors became highly stratified. As a result, access to and mastering of specialized professional knowledge was a requirement for both making and assessing membership claims. The lack of substantive knowledge by a non-expert audience (consumers) led to a great dependence both on the expert audiences (also Vergne & Wry, 2014), and on concrete prototypes, such as Benecol. However, we find that there is leeway in making and assessing knowledge claims. While previous research does show that professional knowledge and regulation play major roles in how categories emerge and mature (e.g. Navis & Glynn, 2010), it does not explore how these are in interaction. Complementing

some foundational work that suggests that experts differ from novices in making elaborate distinctions (Murphy & Medin, 1985; Rottman et al., 2012), we show how experts representing different category audiences (scientists, authorities and regulators) may have varying principles for assessing causality and therefore may disagree on knowledge claims. In this situation, the power position of the actors seems to influence the outcome of the negotiation processes. Once in place, such regulations limit the attention and innovation of both producers and audiences (Schneiberg & Berk, 2010). In this regard, our findings underline a more institutionalist understanding of the role of professions in market categorization, by uncovering the role of power, knowledge, and professional agency in market-making (Muzio et al., 2013; Scott, 2008).

Furthermore, a wealth of studies argues that mature categories are coherent by both their offering and knowledge base. For example, Woolley and Fuchs (2011) discuss the clarifying power and the limiting nature of definitions: narrower definitions allow room for more focused and dedicated activity, which further constructs a coherent category. The stronger and more articulated the knowledge base, the harder it is for actors to join the category without substance, by merely signaling similarity. In this way, causal-based categorization has a major impact on what can become a prototype by demarcating non-substantive activities. Regulators, for instance, draw heavily on causal-based models in their category assessment and boundary drawing. Therefore, in regulated market categories prototypes develop in relation to professional knowledge, where proving the link between a product and an effect is a requirement. This stresses a strong connection between prototypes and causal-based categorization. Such deeper understanding of causal dynamics is critical for explaining and predicting categorization outcomes in various social and economic contexts (Rottman et al., 2012).

On the other side of the coin, for functional foods the stringent rules for inclusion made it risky to invest resources in this market category. This uncovers that, in a strict form, tight boundaries and narrow definitions may reduce goal-based categorization, the side effect of which is diminishing vitality, creativity, and renewal of a category. We thus find that both overly lax boundaries, such as those observable in nanotechnology, and overly strict demands for a narrow knowledge base, in functional foods, may limit incentives to participate in a category, which may lead to category decline. Market categories therefore benefit from being inclusive and exclusive simultaneously so as to secure both vitality and innovation, and at the same time guard the coherence of and commitment to a category.

Taken together, our findings contradict the extant research on categorization that stresses similarity as the key categorization principle and assumes full knowledge and a major degree of impartiality among audiences' categorization activities (e.g. Hannan et al., 2007). We find that prototypes, causality, and goals are all prevalent drivers across different stages of the category development, and are each inextricably connected to the interactions among producers and audiences. Our study therefore contributes to developing new understanding of the interplay among producers and audiences, and the varying dynamics of this interaction throughout category development.

Limitations and Avenues for Future Research

While the study has certain limitations, it raises intriguing directions for enriching the categorization literature. In terms of limitations, the findings are strongly bound to the Finnish context and its particular organizations and institutions that guide category formation and development. The top-down research and technology policy that we observe is characterized by centralized attempts to support novel industries. This, however, seems to be a typical response to globalization by several small and open economies (e.g. Goorden, 2004). Similar local organizations, activities and interests are present in most other market contexts,

including the United States, where public funding plays a role in directing attention towards novel domains (see for example Granqvist & Laurila, 2010).

Further, we compared the development paths of two science-based, interdisciplinary market categories. Perhaps the interdisciplinary nature enabled leeway for divergent interpretations and sense-making by category participants, which Benders and van Veen (2001; see also Ansari et al., 2010) refer to as “interpretive viability”. This ambiguity motivated and allowed a broad range of actors to claim membership in the category. We claim that market categories – even science-based ones – are more flexible, dynamic, and fuzzy than what has been assumed in most previous studies. However, there may be categories with far less permeable boundaries where the dynamics may be quite different. Future research could thus continue exploring drivers and processes of category development in different market categories across varying organizational and institutional contexts.

Our study also uncovered that expert audiences disagreed on knowledge claims, further establishing that category emergence and development is inherently a contested and negotiated enterprise. Future research could examine how the participation of and interaction among various groups of professionals influence category development. Important contributions could be made in studies that shed light on how actors’ power and legitimacy influence on whether their knowledge claims are assessed as relevant or correct, and how this might influence emerging regulations and policy making in new market categories.

Finally, joining recent research challenging the key tenets of categorization activities relating to prototypes (Curchod et al. 2014; Durand & Paoletta, 2013; Granqvist et al., 2013; Glynn & Navis, 2013; Kennedy & Fiss, 2013; Navis & Glynn, 2011), the current study opens novel directions for studying categories and categorization. These studies view categories as complex social objects, and categorization as the social interplay of actors with varying and evolving perceptions, knowledge, and interests, rather than as automated and mechanistic

acts. From this perspective, category labels are resources that actors can draw upon to build temporary or permanent positions within a market. Future studies should develop further inductive, empirically grounded approaches on how actors engage in this negotiation. Such studies may provide interesting insights into market categorization as a practice.

ACKNOWLEDGEMENTS

We wish to thank Associate Editor Gerardo Patriotta and three anonymous reviewers for their constructive and thoughtful guidance throughout the review process. We much appreciate the comments received from Lionel Paoletta, Rebecca Piekkari and James Collins. We further acknowledge the input we received from colleagues in the Academy of Management Conference 2012 in Boston, the HOTREG and the Organization and Management Research Seminars in Helsinki, where we presented earlier versions of the article.

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Table I: Overview of key drivers of categorization across the category development

	FUNCTIONAL FOODS	NANOTECHNOLOGY
CATEGORY EMERGENCE		
Producers		
Drivers, actors and content of categorization	CAUSAL: Scientists establish the causal connection between food and health	GOAL: Scientists adopt the label for accessing funding
Audiences		
Drivers, actors and content of categorization	CAUSAL: Media makes sense of the functional foods concept through causal theorizing PROTOTYPE: Benecol as emerging prototype begins to shape the categorization	GOAL: Public funding bodies aim to initiate new collaborations, and to create a new industry CAUSAL: Public funding bodies develop and share understandings on what is "small enough" size scale, but ambiguous
CATEGORY GROWTH		
Producers		
Drivers, actors and content of categorization	GOAL: Firms and scientists relabel existing activities, often through ceremonial association with functional foods PROTOTYPE: Firms signal similarity (e.g. with Benecol) and reposition activities	GOAL: Scientists and firms relabel existing activities through ceremonial association with nanotechnology CAUSAL: Among scientists, a lack of common knowledge base hampers developing causal claims such that would establish boundaries for the category
Audiences		
Drivers, actors and content of categorization	GOAL: Consumers and public funding bodies promote health, funders wish to exhibit a cluster CAUSAL: Regulators assess the safety and efficacy of products PROTOTYPE: Consumers relate with exemplary products (Benecol)	GOAL: Public funding bodies want to exhibit a cluster which adds leeway to their assessments of membership claims PROTOTYPE: Public funding bodies assess for sufficient resemblance only
CATEGORY MATURITY - FUNCTIONAL FOODS		CATEGORY DECLINE - NANOTECHNOLOGY
Producers		
Drivers, actors and content of categorization	GOAL (negative): Firms have little incentives to develop new products due to overly strict regulations	GOAL (negative): Firms disappointed with the lack of opportunities and dedication by public funders and disengage
Audiences		
Drivers, actors and content of categorization	CAUSAL: Authorities assess health claims against the strict regulations	GOAL (negative): Public funders have poor future expectations due to the lack of dedicated action among producers PROTOTYPE: Public funders see no truly exemplary products or firms

Table II: Empirical illustrations of categorization dynamics

Category emergence	
1.1	It [Benecol] mainly intended to lower cholesterol level and prevent coronary heart disease and arterial disease. – Emeritus Professor in Medicine (functional foods producer, causal-driven)
1.2	The journal of Dental Research published an article in December 1995 where it was told that the use of chewing gum sweetened 100 percent with xylitol five times a day stops the decay and strengthens teeth. – Helsingin Sanomat 10.4.1997 (functional foods audience, causal-driven)
1.3	The efficacy of Benecol has been studied in over 40 clinical studies. In these studies, serum LDL-cholesterol was reduced by 10 to 15 percent. – Sales Director of Raisio Group quoted in Kauppalehti December 10, 2004 (functional foods producer, causal-driven)
1.4	This type of research had been conducted for a long time all over but stakes were not that high [...] We thought we could get more investments in the area when we set up this [nanotechnology] research program. First, we could get proper collaboration [with another public funding agency], this was politically valuable [...]. Second, we could get international visibility. Third, we could initiate new kind of collaboration in research groups. – Technology expert (nanotechnology audience, goal-driven)
1.5	From chemist's point of view the question is, what is new about nano as chemistry [...] it is inherently small and reaches to the nanoscale. And there was the guarding of one's territory. Physicists may have thought that a particular movement of electron [...] is nanotechnology and nothing much else is. [...] These statements aimed towards boosting one's own work or position, or to draw boundaries for the activity. – Technology expert (nanotechnology audience, goal-driven)
Category growth	
2.1	Benecol margarine contains substantial amount of plant sterol called sitostanol, the regular used of which reduces blood cholesterol levels by inhibiting the absorption of cholesterol into the blood. Due to this feature Benecol margarine is a so-called functional food. – Helsingin Sanomat, 12 May, 1997 (functional foods audience, prototype-driven)
2.2	It was due to the enormous success of Benecol, major interest by media and hype that made other actors such as Unilever to join in [the cholesterol lowering category]. – R&D Director (functional foods producer, prototype and goal-driven)
2.3	What we criticize here in the research and academic community is that there is no support for real innovations like Benecol, I mean what starts from [basic] research... but rather money is given to rather secondary product development. – General Director, National Public Health Institute (functional foods audience, goal-driven)
2.4	Tens of millions of euros in spent each year for research in the field [functional foods]. Many actors want to join the growing sector, and all their means do not stand the light of day. – Helsingin Sanomat, 8 November, 2002 (functional foods audience, goal-driven)
2.5	[the company dealing with nanofluidistics has been categorized as a nanofirm] We can say that without us knowing we have been one of the leading firms in nanotechnology ... we have not been promoting ourselves as a nanofirm. – CEO, medical diagnostics firm (nanotechnology producer, prototype-driven)
2.6	At some stage we were considering that we [position ourselves as] "a true micro-optics company!" We wanted to differentiate our firm [from competitors] and say that if a firm that in our view does millimeter optics says they do micro-optics, then what we do is nano-optics. [...] These are purely business decisions. – Entrepreneur, micro-optics company (nanotechnology producer, goal-driven)
2.7	Nowadays when people do these webanalyses, that is real quasi-science. You find that huge numbers of nanotechnology companies have been established, the explosive use of the nano-word. It does not describe how activities in this field have developed. Old firms have adopted a new nano-name, or established nano-divisions. Before they have used some other name for their technology, but now it is called nano. – Principal scientist, consumer electronics company (nanotechnology producer, goal-driven)

Table II (continued): Empirical illustrations of categorization dynamics

Category maturity	
3.1	The EU [approval] process took exactly three years - one could write a paper or book about it. It was catastrophic...If something kills the competitiveness of EU in the future, it is the inability of small and medium sized enterprises to access the markets. – CEO of a functional foods firm (functional foods producer, goal-driven)
3.2	This [regulation] works as preventive so that it doesn't make sense to conduct research on functional foods... No matter how good research you would conduct EFSA [European Food Safety Authority] can notify that this [proof] is not adequate or that it has been conducted incorrectly. – Vice President Technology (functional foods produce, goal-driven)
3.3	These are the [consumer] trends that we have to live with... It is useless to try to go against them. – Vice President Technology (functional foods producers, goal-driven)
Category decline	
3.4	We have a new program called Functional Materials ... 40 percent of activities can be said to relate to nano ... To a large part same actors form part of the materials program. – Director, technology agency (nanotechnology audience, causal and goal-driven)
3.5	Nanotechnology is not the goal, it is the means for producing something. The goal cannot be to produce nanotechnology but you need to think what you want to achieve. If you can do it better by using another technology than nano, why don't you use that one. – Professor, physics (nanotechnology producer, causal-driven)
3.6	Nano is not relevant anymore ... It has lost its sexyness because the firms that benefit from nanotechnology already do products at this stage and those products are in the markets and that is business as usual. Nano [as a label] as such does not have so much benefit... It is a multi-purpose technology that does not really show [in the final product] but it is used nevertheless. – Entrepreneur, materials company (nanotechnology producer, goal-driven)

Figure 1: Cases on a timeline

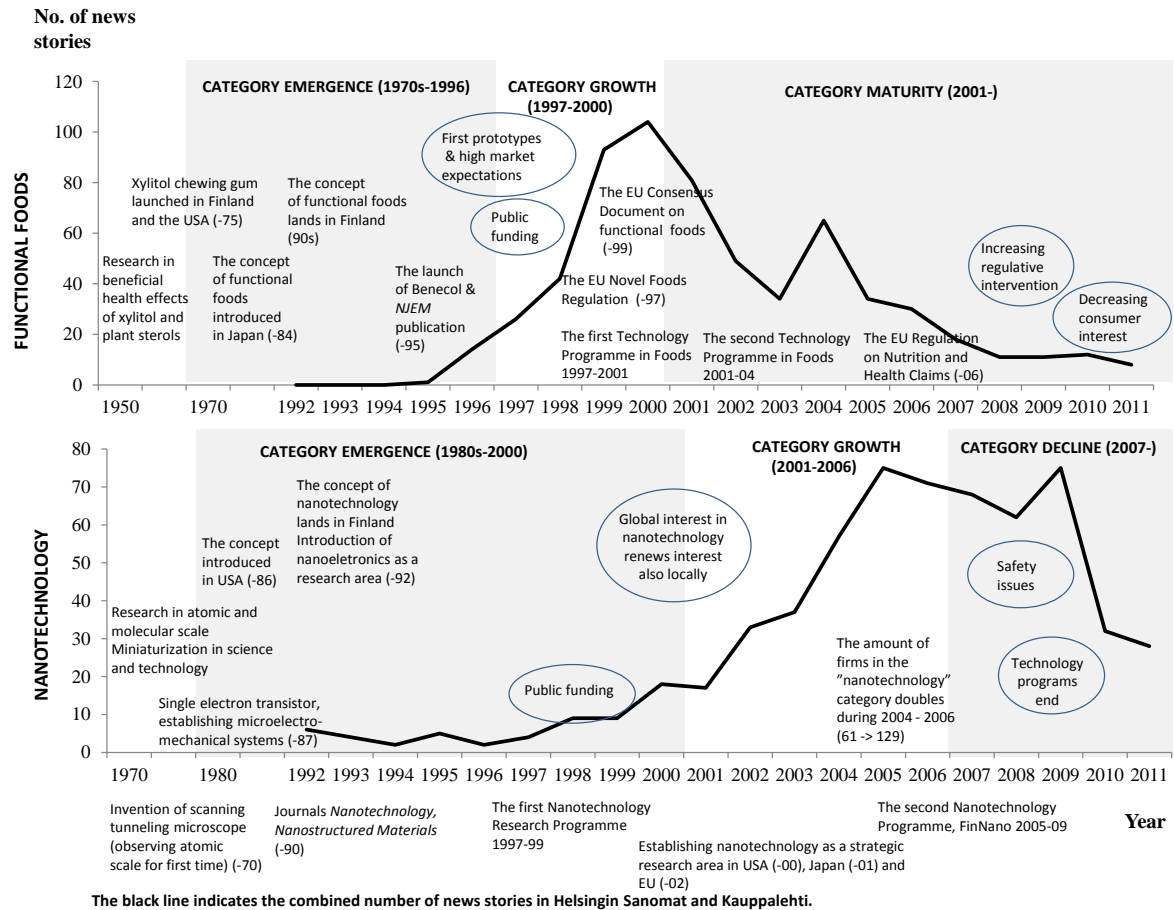


Figure 2: Key actors in the media (N=1331)

